



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
23.04.2014 Bulletin 2014/17

(51) Int Cl.:
B61F 1/08 (2006.01) B61D 17/00 (2006.01)

(21) Application number: **12800090.8**

(86) International application number:
PCT/JP2012/062855

(22) Date of filing: **18.05.2012**

(87) International publication number:
WO 2012/172925 (20.12.2012 Gazette 2012/51)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **14.06.2011 JP 2011132600**

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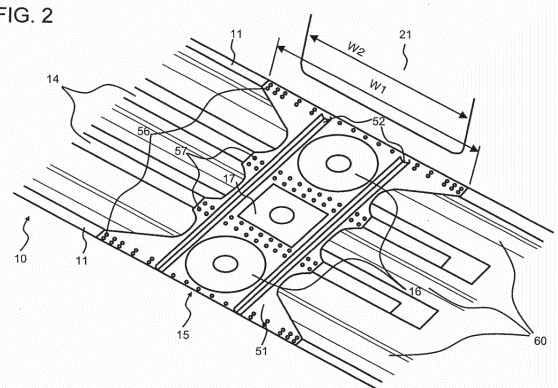
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(54) **VEHICLE BODY STRUCTURE ADAPTED FOR USE IN RAILROAD VEHICLE AND PROVIDED WITH WIRE/PIPE MODULE, AND METHOD FOR MANUFACTURING SAME**

(57) A vehicle body structure in which wires and pipes are laid under the floor is configured in such a manner that wires and pipes in the vicinity of a bogie, the vicinity being that in which a sufficient space for the wires and pipes cannot be ensured, are simplified. A bolster beam (15) is fastened at the fastening sections (56, 57) thereof by bolts to the lower surfaces of side beams (11) and to the lower surfaces of center beams (14). The lower surfaces of the side beams (11) and the lower surfaces of the center beams (14) are separated by the same distance in the vertical direction of the vehicle body from the lower surface of an underframe (10), and a sufficient space is present between the lower surface of the underframe (10) and the upper surface of the bolster beam (15). A wire/pipe module (60) is routed through the space. Pipes can be routed straight. In addition, assembling connectors for connecting wires, wires, and pipes in advance by outwork can minimize work at the site for manufacturing the vehicle body, and bundling wires and pipes together into a module facilitates the mounting of the wires and pipes to the vehicle body. The above configuration can reduce cost and lead time required to manufacture the vehicle body.

FIG. 2



Description

[Technical Field]

[0001] The present invention relates to a vehicle body structure having a bolster beam and a center beam crossing the same on a lower surface of an underframe constituting a floor of a railroad vehicle, in which wires and pipes are laid under the floor, and a method for manufacturing the same.

[Background Art]

[0002] Recently, aluminum alloy materials having superior extrusion performance, corrosion resistance and weldability for railroad vehicles have been developed. Along therewith, the current trend of railroad vehicles is to adopt vehicle bodies effectively utilizing large-sized shape materials made of aluminum alloy, from the viewpoint of reducing weight and rationalizing fabrication.

[0003] The vehicle body (structure) of a railroad vehicle is composed of side structures, end structures, a roof structure and an underframe. On both longitudinal ends of the vehicle body on a lower surface of the underframe are disposed center beams with a coupler for mutually connecting adjacent cars, and bolster beams for supporting the weight of the vehicle body via a bogie. Generally, the center beams and the bolster beams are mutually crossed and assembled to adopt a vehicle body structure having sufficient strength for receiving the heavy load acting on the vehicle body via couplers and bogies. The center beams and bolster beams are extruded shape members made of aluminum alloy and having large sizes, which are welded to the lower surface of the underframe, which is also composed of extruded shape members formed of aluminum alloy.

[0004] Various devices for power supply systems, control systems, high-pressure air systems and so on are crammed into the space under the floor of the railroad vehicle. In this state, wires and pipes connecting these devices are disposed under the floor of the railroad vehicle, but it is difficult to ensure enough space for disposing these wires and pipes, especially in the vicinity of a bogie. A penetration pipe through which wires and pipes are collectively passed is an effective means for ensuring the space for mounting the wires and pipes. Currently, a penetration pipe is disposed on a bolster beam positioned above the bogie, and the wires and pipes are laid through this penetration pipe. One example of such vehicle body structure is a structure illustrated in Figs. 8 and 9 of patent literature 1. Further, the present applicant has proposed a vehicle body structure capable of preventing deterioration of strength of bolster beam and increasing the number of components accompanying the laying of a penetration pipe, by utilizing the space within the center beams for wires and pipes instead of the penetration pipe (refer to Figs. 1 and 2 of patent literature 1).

[0005] On the other hand, a method for reducing the

cost and lead time required to manufacture the vehicle body, such as a method for assembling wires and pipes in advance by outwork, or a method for mounting to the vehicle body a module having bundled multiple wires and pipes together, can be considered. For example, as for wiring, the work to be performed at the manufacture site of the vehicle body can be minimized by assembling connectors to be inserted to devices in advance, and the mounting of wires to the vehicle body can be fabricated by forming a module by bundling together multiple wires.

[0006] However, when the above methods are applied to the space under the floor of the vehicle, there is a drawback that sufficient space for arranging the wires and pipes cannot be ensured in the vicinity of the bogie. For example, as for wires, the connectors for connecting the wires do not pass through the space formed within the penetration pipes or the center beams, so that it was necessary to assemble connectors for connecting wires after passing the wires to the space within the penetration pipes or the center beams, and as for pipes, they had to be bended arbitrarily corresponding to the positions for passing pipes in the space within the penetration pipes or the center beams. Therefore, it was difficult to assemble wires and pipes to be disposed under the floor by outwork, or to mount the wire/pipe module under the floor, so that sufficient reduction of cost and lead time for manufacturing the vehicle body had not been possible according to the prior art.

[Citation List]

[Patent Literature]

[PTL 1]

[0007] Japanese Patent Application Laid-Open Publication No. 2009-255641

[Summary of Invention]

[Technical Problem]

[0008] Thus, the problem to be solved according to the present invention is to realize a vehicle body structure having wires and pipes laid under the floor of the vehicle, wherein sufficient space for passing wires and pipes in the vicinity of a bogie can be ensured, and a method for manufacturing such vehicle body structure.

[0009] The object of the present invention is to ensure sufficient space for disposing wires and pipes in the vicinity of a bogie, enable assembling of wires and pipes to be disposed under the floor of the vehicle by outwork, and enable a wire/pipe module to be mounted under the floor of the vehicle, to thereby provide a vehicle body structure capable of reducing the cost and lead time required to manufacture the vehicle body, and the method for manufacturing the same.

[Solution to Problem]

[0010] In order to solve the problems and achieve the objects mentioned above, the vehicle body structure according to the present invention has an underframe formed by joining side beams disposed at both width-direction ends of a vehicle body and extending in a longitudinal direction of the vehicle body, bolster beams disposed to extend in the width direction of the vehicle body, and center beams crossing the bolster beams and extending in the longitudinal direction of the vehicle body toward end sections of the vehicle body; wherein the bolster beams are joined to a lower surface or a side surface of the side beams and the center beams; and wires and pipes are passed through a space formed between the underframe and the bolster beams.

[0011] Further, the method for manufacturing a vehicle body structure having a wire/pipe module disposed on a lower surface of the underframe according to the present invention has an underframe formed by joining side beams disposed at both width-direction ends of a vehicle body and extending in a longitudinal direction of the vehicle body, bolster beams disposed to extend in the width direction of the vehicle body, and center beams crossing the bolster beams and extending in the longitudinal direction of the vehicle body toward end sections of the vehicle body; the method comprising: a step of securing the wire/pipe module to the lower surface of the underframe; a step of arranging the bolster beams to the lower surface of the underframe astride the wire/pipe module disposed on the lower surface of the underframe; and a step of fixing the arranged bolster beams to a lower surface or a side surface of the side beams and the center beams.

[Advantageous Effects of Invention]

[0012] According to the vehicle body structure and the method for manufacturing the same of the present invention, sufficient space for wires and pipes can be ensured in the vicinity of a bogie, and the assembling of wires and pipes to be disposed under the floor of the vehicle by outwork and the mounting of wire/pipe modules under the floor of the vehicle using this space becomes possible, so that the cost and lead time required to manufacture the vehicle body can be reduced.

[Brief Description of Drawings]

[0013]

[Fig. 1] Fig. 1 is a perspective view of a bottom surface illustrating one embodiment of a vehicle body structure according to the present invention.

[Fig. 2] Fig. 2 is a perspective view showing section A of the vehicle body structure illustrated in Fig. 1 in enlarged view.

[Fig. 3] Fig. 3 is a perspective view showing a bolster

beam from an underframe side.

[Fig. 4] Fig. 4 is a view showing an underframe prior to mounting wires and pipes.

[Fig. 5] Fig. 5 is a view showing an underframe after mounting the wires and pipes.

[Fig. 6] Fig. 6 is a view showing an underframe after mounting the bolster beam.

[Fig. 7] Fig. 7 is a cross-sectional view taken at plane B-B of the underframe shown in Fig. 6 after mounting the bolster beam.

[Fig. 8] Fig. 8 is a perspective view showing section A in enlarged view according to another embodiment of a vehicle body structure of the present invention.

15 [Description of Embodiments]

[0014] Now, a preferred embodiment of a vehicle body structure and a method for manufacturing the same according to the present invention will be referred to with reference to the drawings.

[0015] Fig. 1 is a perspective view of a bottom side of a vehicle body structure according to one preferred embodiment of the present invention (perspective view showing the vehicle body from the bogie side), Fig. 2 is a perspective view illustrating section A of the vehicle body structure shown in Fig. 1 in enlarged view, and Fig. 3 is a perspective view showing a bolster beam from the underframe side.

[0016] According to the vehicle body structure illustrated in Figs. 1 through 3, a vehicle body 1 is composed of side structures 20 and 20 (only one of which is shown) erected from both width-direction ends of an underframe 10, end structures 30 and 30 erected from both longitudinal ends of the underframe 10, and a roof structure 40 mounted to the upper ends of side structures 20 and 20 and end structures 30 and 30. Side beams 11 and 11 to be coupled to side structures 20 and 20 are disposed on both width-direction ends of the underframe 10, and end beams 12 and 12 to be coupled to end structures 30 and 30 are disposed on both longitudinal ends of the underframe 10.

[0017] Coupler bearings 13 and 13 having couplers (not shown) for coupling a vehicle body 1 to adjacent vehicle bodies are disposed close to a center area in the width direction of the end beams 12 and 12, and center beams 14 and 14 extending in the longitudinal direction of the underframe 10 are arranged at a rear section (close to a longitudinal center of the underframe 10) of the end beams 12 and 12. Bolster beams 15 and 15 extending in the width direction of the underframe 10 are disposed at a position separated by a given distance from the end beams 12 and 12 toward the longitudinal center area of the underframe 10. The bolster beams 15 and 15 are connected to the center beams 14 and 14, and also connected to a bogie (not shown) at positions corresponding to air spring bearings 16 and 16 and center pin bearings 17 and 17.

[0018] Doorways 21, 21 and 21 through which passen-

gers can get on or off the vehicle and multiple windows are formed on the side structures 20 and 20. The longitudinal positions of the two doorways 21 and 21 arranged close to the ends of the body vehicle on the side structure 20 are close to the longitudinal positions of the bolster beams 15 and 15 on the underframe 10.

[0019] The underframe 10, the side structures 20 and the roof structure 40 are formed by arranging multiple hollow extruded shape members formed of aluminum alloy along the longitudinal direction of the vehicle body, and joining the width-direction ends of the adjacent hollow extruded shape members. The end structures 30 are formed by joining plate-like members and beam-like members made of aluminum alloy. The side beams 11 are hollow extruded shape members made of aluminum alloy arranged along the longitudinal direction of the vehicle body, and are joined to both width-direction ends of the underframe 10. End beams 12 are formed by joining plate-like members and beam-like members formed of aluminum alloy, and are joined to both longitudinal ends of the underframe 10. The joining of the side beams 11 to the side structures 20 and the side structures 20 to the roof structure 40 are performed via mechanical fastening means such as bolts and rivets. The joining of the end structures 30 to end beams 12, side structures 20 and the roof structure 40 are performed via mechanical fastening means such as bolts and rivets.

[0020] The center beams 14 are extruded shape members having an I-shaped cross-sectional shape (a shape formed by tipping an H-shape sideways; refer to Fig. 7) formed of aluminum alloy and arranged along the longitudinal direction of the vehicle body, which are joined to the lower surface of the underframe 10 and the rear sides of the end beams 12 (near the longitudinal center area of the underframe 10). The cross-sectional shape of the center beams 14 can be U-shaped, for example, instead of I-shaped. The end beams 12 and the center beams 14 may be formed of steel, and in that case, the beams are connected to the underframe 10 using mechanical fastening means such as bolts and rivets. The fastening of the end beams 12 and the center beams 14 is realized by welding if the beams are formed of identical materials, and realized by mechanical fastening means such as bolts and rivets if the beams are formed of different materials. However, if the center beams 14 extending for a long distance in the longitudinal direction of the vehicle body are formed of steel, it is difficult to manage the flatness of the beams since mechanical fastening means must be used to join the beams to the underframe 10, and the weight thereof increases significantly. Therefore, from the viewpoint of managing fabrication of the vehicle body and reducing the weight thereof, it is better to join the center beams 14 formed of aluminum alloy to the underframe 10 via welding.

[0021] The bolster beams 15 are formed by welding width-direction beams 52 and 53 and longitudinal beams 54 and 55 which are beam-like members made of steel to plate-like members 51 made of steel. The plate-like

member 51 can be formed by cutting a single plate member, or can be formed by joining multiple plate members. Air spring bearings 16 and a center pin bearing 17 which join air springs and a center pin which are components disposed on the bogie side are smoothly finished to correspond to the shapes of the components disposed on the bogie side, so that they can be coupled accurately to the bogie. Each plate-like member 51 has projections protruded toward the longitudinal direction of the underframe 10 at positions corresponding to the side beams 11 and the center beams 14. A longitudinal distance W1 of the underframe 10 between the ends of both projections corresponding to the position of the side beams 11 is greater than a width W2 of a doorway 21 disposed close to the bolster beam 15. The plate-like member 51 is fastened via bolts to the lower surface of the side beams 11 at bolt fastening sections 56 (only a portion of which is denoted by the reference number) corresponding to the positions of the side beams 11, and via bolts to the lower surface of the center beams 14 at bolt fastening sections 57 (only some of which are denoted by the reference number) corresponding to the positions of the center beams 14. The distances between the bolt fastening sections 56 and 57 in the longitudinal direction of the underframe 10 are small near the end of the projections. Since the lower surface of the side beams 11 and the lower surface of the center beams 14 are separated from the lower surface of the underframe 10 by the same distance in the vertical direction of the vehicle body, the plate-like member 51 is substantially parallel with the underframe 10, and sufficient space exists between the lower surface of the underframe 10 and the upper surface of the plate-like member 51.

[0022] Width-direction beams 52 are joined to the lower surface of the plate-like member 51 at positions that do not interfere with the air spring bearings 16 and the center pin bearing 17. Width-direction beams 53 are attached to the upper surface of the plate-like member 51 at positions close to a rear surface of the width-direction beams 52 joined to the lower surface of the plate-like member 51, and are attached at both ends thereof to the longitudinal beams 54. Multiple longitudinal beams 55 are joined to the rear surfaces corresponding to positions of the air spring bearings 16 and the center pin bearing 17, and are joined at both ends thereof with the width-direction beams 53. The height of the width-direction beams 53 and the longitudinal beams 54 and 55 in the vertical direction of the vehicle body attached to the upper surface of the plate-like member 51 is smaller than the distance between the lower surface of the underframe 10 and the upper surface of the plate-like member 51.

[0023] On the lower surface of the underframe 10 are joined wire/pipe modules 60 having bundled multiple wires and pipes along the longitudinal direction of the vehicle body. An appropriate method is selected for joining the wire/pipe module 60 to the lower surface of the underframe 10 according to the design and material of the wire/pipe modules 60, such as screws, bolts and ad-

hesives. The wires and pipes joined to the respective devices are branched from the wire/pipe modules 60 near the respective devices. In the vicinity of a bogie, the wire/pipe modules 60 are passed through the space formed between the lower surface of the underframe 10 and the upper surface of the plate-like member 51 of the bolster beam 15. Therefore, the vertical height of the width-direction beams 53 attached to the upper surface of the plate-like member 51 in the vehicle body is suppressed to a level allowing the wire/pipe module 60 to pass through the lower surface of the underframe 10. The wire/pipe modules 60 are passed through areas that do not interfere with the longitudinal beams attached to the upper surface of the plate-like member 51.

[0024] Now, we will describe the procedure for mounting the wires and pipes to the vehicle body according to the present embodiment. Fig. 4 shows a view of an underframe prior to mounting the wires and pipes (showing the lower surface of the underframe from the upper side). The underframe 10 is placed on a surface plate (not shown) in the state shown in the drawing (state in which the lower surface of the underframe faces up), wherein side beams 11 and 11 are attached to both width-direction ends, end beams 12 and 12 are attached to both longitudinal ends, and center beams 14 and 14 are attached rearward from each end beams 12 (close to the center in the longitudinal direction of the underframe 10), respectively. In this state, the wire/pipe modules 60 are mounted to a lower surface (the upper side in the drawing) at positions that do not interfere with the center beams 14.

[0025] Fig. 5 illustrates the underframe after having the wires and pipes mounted thereto (showing the lower surface of the underframe from the upper side). In this state, the bolster beam 15 is fastened via bolts to the lower surface (the upper side in the drawing) of the side beams 11 and the center beams 14. At this time, the positions of the wire/pipe modules 60 are adjusted in advance so that the wire/pipe modules 60 do not interfere with the beam-like members of the bolster beams 15. Fig. 6 is a view of the underframe having mounted the bolster beams (showing the lower surface of the underframe from the upper side), and Fig. 7 shows a B-B cross-section of Fig. 6. The positions of the longitudinal beams 54 disposed on both width-direction ends of the vehicle body and the longitudinal beams 55 disposed on the rear surface of the air spring bearing 16 and the center pin bearing 17 of the bolster beam 15, the center beams 14 and the wire/pipe modules 60 all differ in the width-direction of the vehicle body, and they do not interfere with one another. Thereafter, after joining the side beams 11 to the side structures 20 and the side structures 20 to the roof structure 40 via mechanical fastening means such as bolts and rivets, the end structures 30 and the end beams 12, the side structures 20 and the roof structure 40 are joined via mechanical fastening means such as bolts and rivets. The vehicle body structure manufactured via the above-described process becomes the vehicle body

structure illustrated in Fig. 1.

[0026] According to this arrangement, the wires and pipes can be passed through the wide space formed between the lower surface of the underframe 10 and the upper surface of the bolster beam 15, allowing the connectors for connecting wires to be assembled in advance or the pipes to be routed straight, so that the wires and pipes can be assembled in advance by outwork to minimize the work performed in the manufacturing site of the vehicle body, and the mounting of wires and pipes to the vehicle body can be facilitated by bundling multiples wires and pipes together into a module. Even further, the vehicle body after having the wire/pipe modules 60 mounted is fabricated using mechanical fastening means such as bolts and rivets, so that the damaging of the wires and pipes by the heat applied during welding can be prevented. Therefore, wires and pipes can be mounted through operations performed by looking down at the underframe 10. According to this arrangement, the cost and lead time required to manufacture the vehicle body can be reduced.

[0027] In the present arrangement where the main member of the bolster beam 15 is a plate-like member 51, there is fear that the bolster beam 15 may lack sufficient strength, but since the longitudinal and width-direction beam-like members 52 through 55 receive the load applied from the bogie in the left-right directions and the front-rear directions, and the beam is formed of steel having a high strength, sufficient strength can be ensured to various loads applied thereto during operation including the load applied from the coupler. Furthermore, in the bolt fastening sections where load is applied in a concentrated manner, projections are formed to increase the number of bolts, and the intervals between fastening of bolts in the projections where load is concentrated are shortened to strengthen these sections. In addition, according to the present embodiment where the doorways 21 are positioned close to the bolster beams 15, the distance W1 between the projections of the bolster beams 15 corresponding to the position of the side beams 11 is set greater than width W2 of the doorways 21, so that the load applied on the bolt fastening sections can be transmitted reliably to the side structures.

[0028] In the present embodiment, the bolster beam 15 is made of steel, but a similar effect can be exerted even if the beam is made of aluminum alloy. In that case, the plate thickness of the plate-like members 51 of the bolster beams 15 must be increased, so that the space for passing the wires and pipes is reduced, but the weight of the bolster beams 15 can be reduced. In that case, the side beams 11, the center beams 14 and the bolster beams formed of the same material can be joined via welding. However, welding must be performed carefully so that the wires and pipes are not damaged by the heat applied during welding.

[0029] Further according to the present embodiment, the side beams 11, the center beams 14 and the bolster beams 15 are fastened via bolts, but they can be fastened

via rivets to exert the same effects. In that case, re-fastening of the bolster beams 15 will be difficult, but the work time can be shortened.

[0030] According further to the present embodiment, the bolster beams 15 are joined to the lower surface of the side beams 11 and the center beams 14, but even if the bolster beams 15 are joined to the side surface of the side beams 11 and the center beams 14, the same effects can be exerted. In that case, the bolster beams 15 must be formed in a divided manner, so that fabrication of the bolster beams takes time and effort, but the height of the center beams 14 can be increased, so that the strength of the beams can be advantageously increased.

[0031] Fig. 8 is a perspective view showing an enlarged view of section A (refer to Fig. 1) according to another embodiment of the vehicle body structure of the present invention.

[0032] The procedures for mounting to the vehicle body the wires and pipes and the vehicle body structures omitting the structures of the bolster beams 15 are the same as the embodiment illustrated in Figs. 1 through 7, so that detailed descriptions of the components, the materials and the procedures are omitted. The reference numbers used in the descriptions and drawings in the present embodiment are the same as the numbers referred to in Figs. 1 through 7.

[0033] The bolster beam 15 is a composite structure body formed of a lower side plate-like member 71, an upper side plate-like member 72 and multiple ribs 73 (only a portion of which is denoted by the reference number) connecting these plate-like members made of aluminum alloy, which are formed by welding multiple extruded shape members and plate members. Air spring bearings 16 and a center pin bearing 17 which join air springs and a center pin which are components disposed on the bogie side are smoothly finished to correspond to shapes of the components disposed on the bogie side, so that accurate coupling with the bogie is realized. The bolster beam 15 has projections protruded toward the longitudinal directions of the underframe 10 at positions corresponding to the side beams 11 and the center beams 14. A longitudinal distance W1 of the underframe 10 between the ends of both projections corresponding to the position of the side beams 11 is greater than a width W2 of a doorway 21 disposed close to the bolster beam 15. The upper side plate-like member 72 is fastened via bolts to the lower surface of the side beams 11 at bolt fastening sections 56 (only a portion of which is denoted by the reference number) corresponding to the positions of the side beams 11, and via bolts to the lower surface of the center beams 14 at bolt fastening sections 57 (only a portion of which is denoted by the reference number) corresponding to the positions of the center beams 14. In the bolt fastening sections 57 positioned to correspond to the center beams 14 excluding the projections, the upper side plate-like member 72 and the lower side of the center beams 14 are fastened via bolts through bolt fastening holes 74 formed to the lower side plate-like

member 71. The distances between the bolt fastening sections 56 and 57 in the longitudinal direction of the underframe 10 are small near the end of the projections. Since the lower surface of the side beams 11 and the lower surface of the center beams 14 are separated from the lower surface of the underframe 10 by a same distance in the vertical direction of the vehicle body, the bolster beam 15 is substantially parallel with the underframe 10, and sufficient space is present between the lower surface of the underframe 10 and the upper surface of the upper side plate-like member 72.

[0034] On the lower surface of the underframe 10 are joined wire/pipe modules 60 having bundled multiple wires and pipes along the longitudinal direction of the vehicle body. An appropriate method is selected for joining the wire/pipe module 60 to the lower surface of the underframe 10 according to the design and material of the wire/pipe modules 60, such as screws, bolts and adhesives. The wires and pipes joined to the respective devices are branched from the wire/pipe modules 60 near the respective devices. In the vicinity of a bogie, the wire/pipe modules 60 are passed through the space formed between the lower surface of the underframe 10 and the upper surface of the upper side plate-like member 72 of the bolster beam 15.

[0035] According to this arrangement, the wires and pipes can be passed through the wide space formed between the lower surface of the underframe 10 and the upper surface of the bolster beam 15, allowing the connectors for connecting wires to be assembled in advance or the pipes to be routed straight, so that the wires and pipes can be assembled in advance by outwork to minimize the work performed in the manufacturing site of the vehicle body, and the mounting of wires and pipes to the vehicle body can be facilitated by bundling multiples wires and pipes together into a module. Even further, the vehicle body after having the wire/pipe modules 60 mounted is manufactured using mechanical fastening means such as bolts and rivets, so that the damaging of the wires and pipes by the heat applied during welding can be prevented. Therefore, wires and pipes can be mounted through operations performed by looking down at the underframe 10. According to this arrangement, the cost and lead time required to manufacture the vehicle body can be prevented.

[0036] According to the present arrangement, since the bolster beam 15 is formed as a composite structure body, even when aluminum alloy is used as material for forming the beam, a sufficient strength can be ensured against various loads that act thereon during operation such as the loads applied from the bogie or the coupler. On the other hand, since the height of the bolster beam 15 is high, the height of the center beams 14 is reduced, and the space for wires and pipes is reduced. Furthermore, in the bolt fastening sections where load is applied in a concentrated manner, projections are formed to increase the number of bolts, and the intervals between fastening of bolts in the projections where load is con-

centrated are reduced to strengthen these sections. In addition, according to the present embodiment where the doorways 21 are positioned close to the bolster beams 15, the distance W1 between the projections of the bolster beams 15 corresponding to the position of the side beams 11 is set greater than width W2 of the doorways 21, and the load applied on the bolt fastening sections can be transmitted reliably to the side structures.

[0037] In the present embodiment, the bolster beam 15 is formed of aluminum alloy, but the same effects can be exerted even if the beam is formed of steel. In that case, the mass of the bolster beam 15 increases, but since it has a high strength, the height of the bolster beam 15 can be reduced and the space for mounting wires and pipes can be expanded.

[0038] According further to the present embodiment, the side beams 11, the center beams 14 and the bolster beams 15 are joined via bolts, but the same effects can be exerted by joining the beams by welding via rivets. If the beams are welded, the joint sections have higher reliability, but the welding must be performed carefully so that the heat of the welding operation will not damage the wires and pipes. When the beams are joined via rivets, it is difficult to re-fasten the bolster beams, but the operation time can be shortened.

[0039] According further to the present embodiment, bolster beams 15 are joined to the lower surface of the side beams 11 and the center beams 14, but the same effects can be exerted even if the bolster beams 15 are joined to the side surfaces of the side beams 11 and the center beams 14. In that case, it is necessary to divide the bolster beams 15, so that the fabrication takes much time and effort, but since the height of the center beams can be increased, it can have advantageous strength.

[0040] The technical scope of the present invention is determined based on the description of the claims and the description of the means for solving the problems, but it can extend to the range easily replaceable by those skilled in the art.

[Reference Signs List]

[0041]

1	Vehicle body
10	Underframe
11	Side beam
12	End beam
13	Coupler bearing
14	Center beam
15	Bolster beam
16	Air spring bearing
17	Center pin bearing
20	Side structure
21	Doorway
30	End structure
40	Roof structure
51	Plate-like member

52, 53	Width-direction beam
54, 55	Longitudinal beam
56, 57	Bolt fastening section
60	Wire/pipe module
5 71	Lower side plate-like member
72	Upper side plate-like member
73	Rib
74	Bolt fastening hole

10

Claims

1. A vehicle body structure having an underframe formed by joining side beams disposed at both width-direction ends of a vehicle body and extending in a longitudinal direction of the vehicle body, bolster beams extending in the width direction of the vehicle body, and center beams crossing the bolster beams and extending in the longitudinal direction of the vehicle body toward end sections of the vehicle body; wherein the bolster beams are joined to a lower surface or a side surface of the side beams and the center beams; and wires and pipes are passed through a space formed between the underframe and the bolster beams.
2. The vehicle body structure according to claim 1, wherein the wires and pipes are formed as a module structure having multiple wires and pipes bundled together.
3. The vehicle body structure according to claim 1, wherein the center beams are formed of aluminum alloy, and welded to the underframe.
4. The vehicle body structure according to claim 1, wherein the bolster beams are each composed of a plate-like member extending in the width direction of the vehicle body and multiple beam-like members extending in the width direction of the vehicle body, the longitudinal direction of the vehicle body or in both directions.
5. The vehicle body structure according to claim 1, wherein the bolster beams are fastened to a lower surface or a side surface of the side beams and the center beams via a mechanical fastening means.
6. The vehicle body structure according to claim 5, wherein a fastening interval of the bolster beams at both longitudinal ends of the bolster beams in the vehicle body of the portion fastened to the side beams and the center beams is smaller than a fastening interval

in the area between said both longitudinal ends.

7. The vehicle body structure according to claim 1,
wherein
the portion of the bolster beams joined to the side 5
beams and the center beams has a longitudinal
length in the vehicle body which is longer than the
longitudinal length of other portions.

8. The vehicle body structure according to claim 1, 10
wherein
the bolster beams are made of steel.

9. A vehicle body structure having an underframe
formed by joining side beams disposed at both width- 15
direction ends of a vehicle body and extending in a
longitudinal direction of the vehicle body, bolster
beams extending in the width direction of the vehicle
body, and center beams crossing the bolster beams
and extending in the longitudinal direction of the ve- 20
hicle body toward end sections of the vehicle body,
and having a doorway disposed near the bolster
beams; wherein
a length of a portion of the bolster beams in the lon- 25
gitudinal direction of the vehicle body joined to the
side beam is longer than a length of the entrance in
the longitudinal direction of the vehicle body.

10. A method for manufacturing a vehicle body structure
having an underframe formed by joining side beams 30
disposed at both width-direction ends of a vehicle
body and extending in a longitudinal direction of the
vehicle body, bolster beams extending in the width
direction of the vehicle body, and center beams
crossing the bolster beams and extending in the lon- 35
gitudinal direction of the vehicle body toward end
sections of the vehicle body, and having a wire/pipe
module disposed on a lower surface of the under-
frame; the method comprising: 40

a step of securing the wire/pipe module to the
lower surface of the underframe;
a step of arranging the bolster beams to the low-
er surface of the underframe astride the 45
wire/pipe module disposed on the lower surface
of the underframe; and
a step of fixing the arranged bolster beams to a
lower surface or a side surface of the side beams
and the center beams. 50

50

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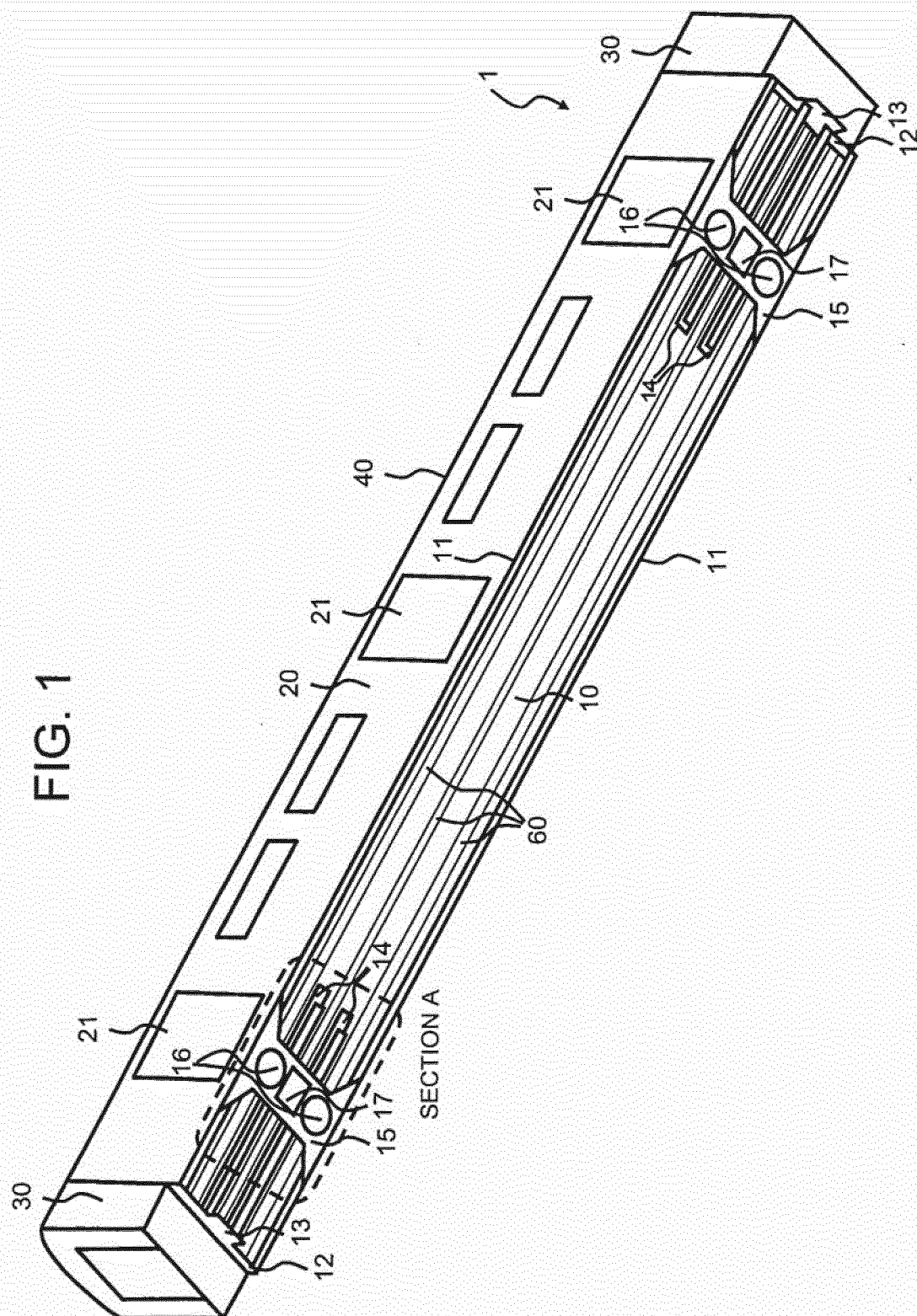
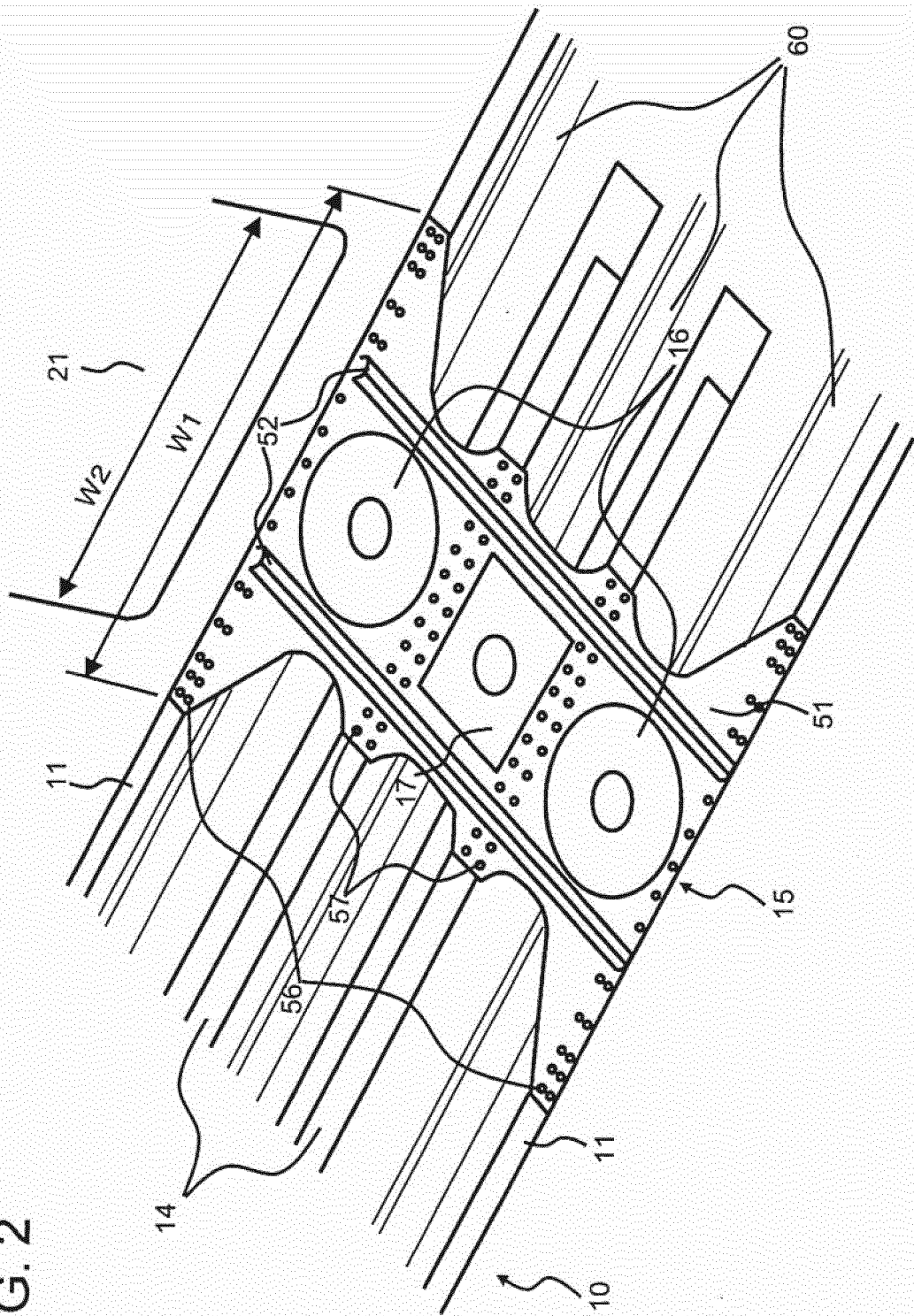
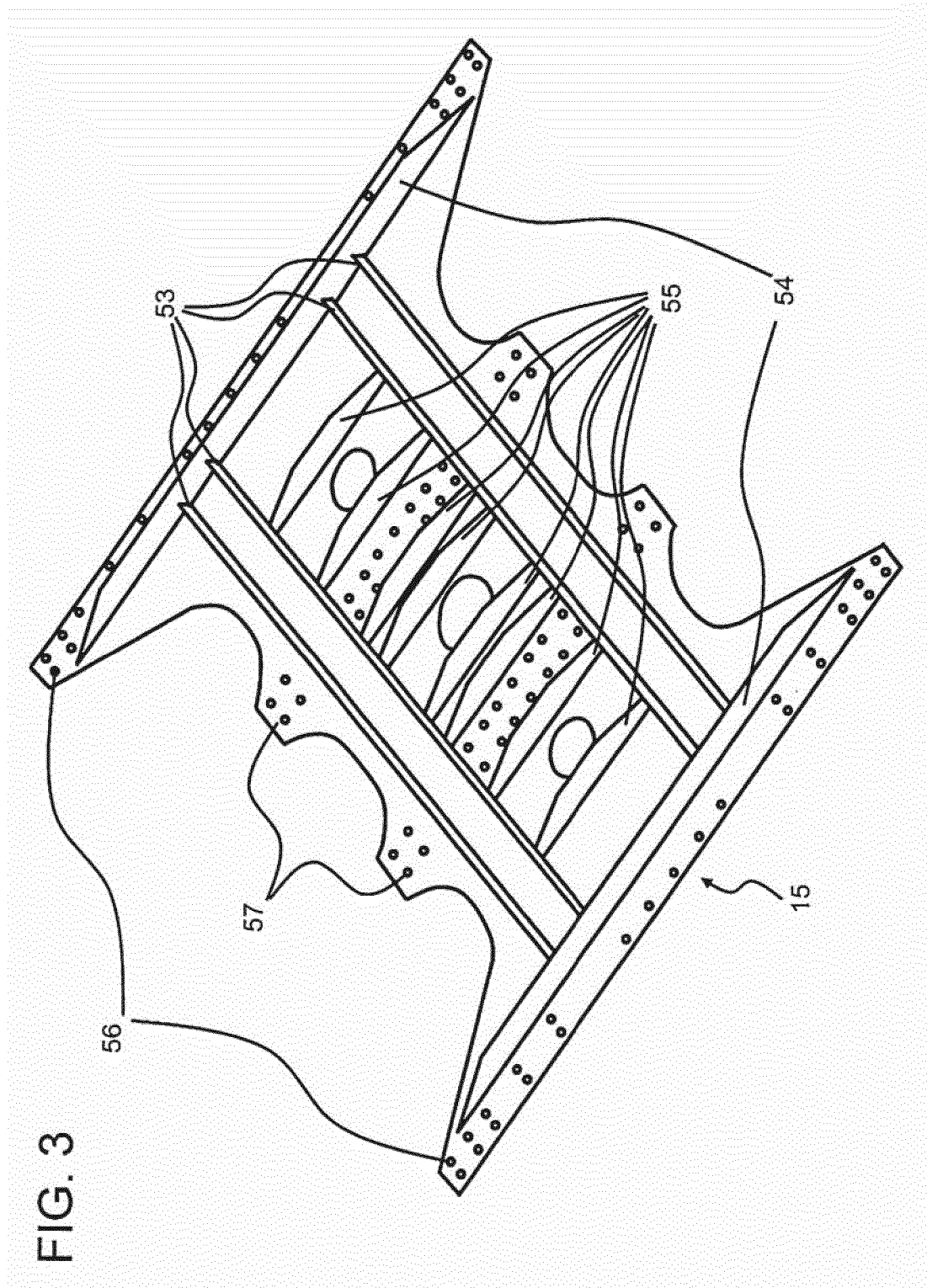
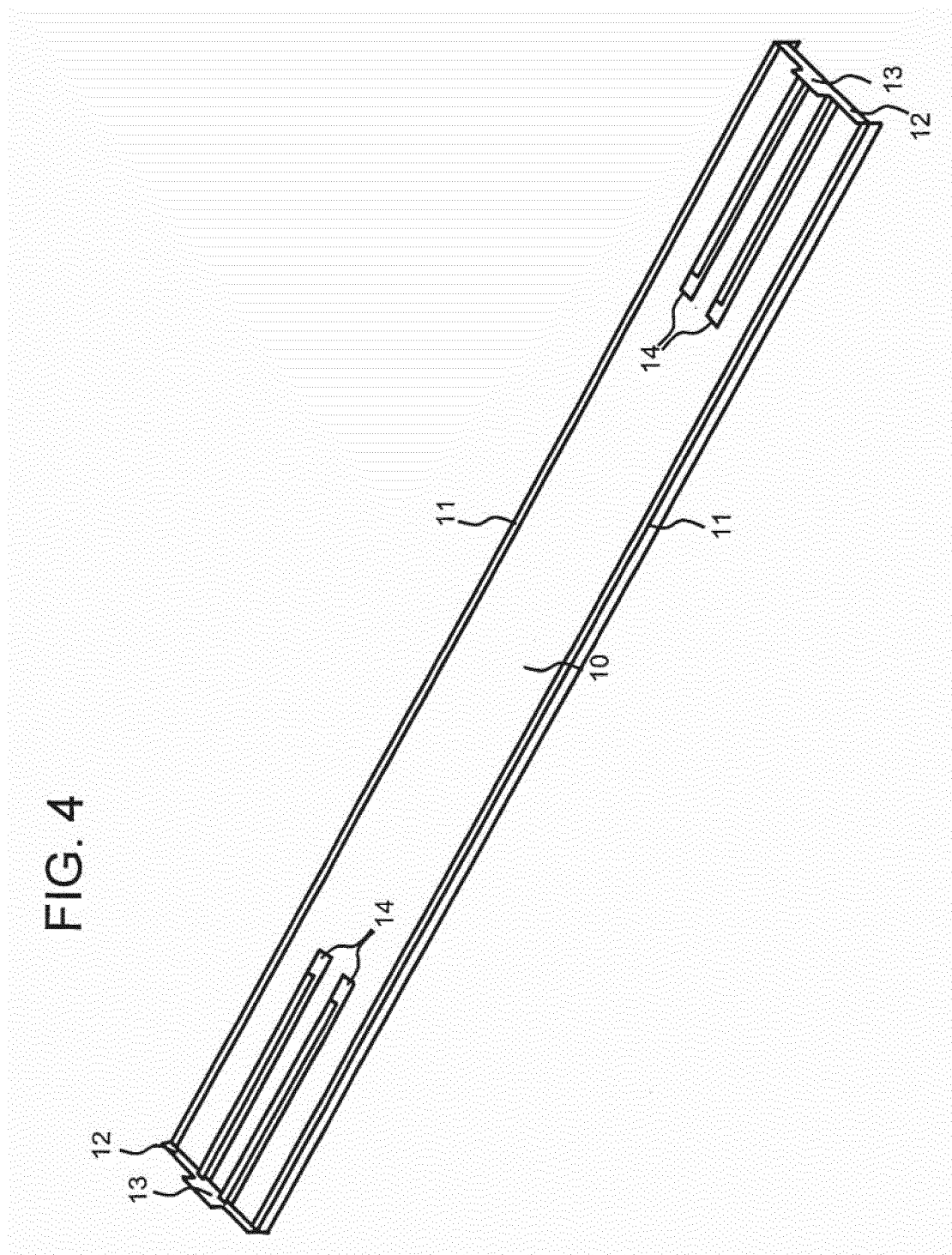


FIG. 2







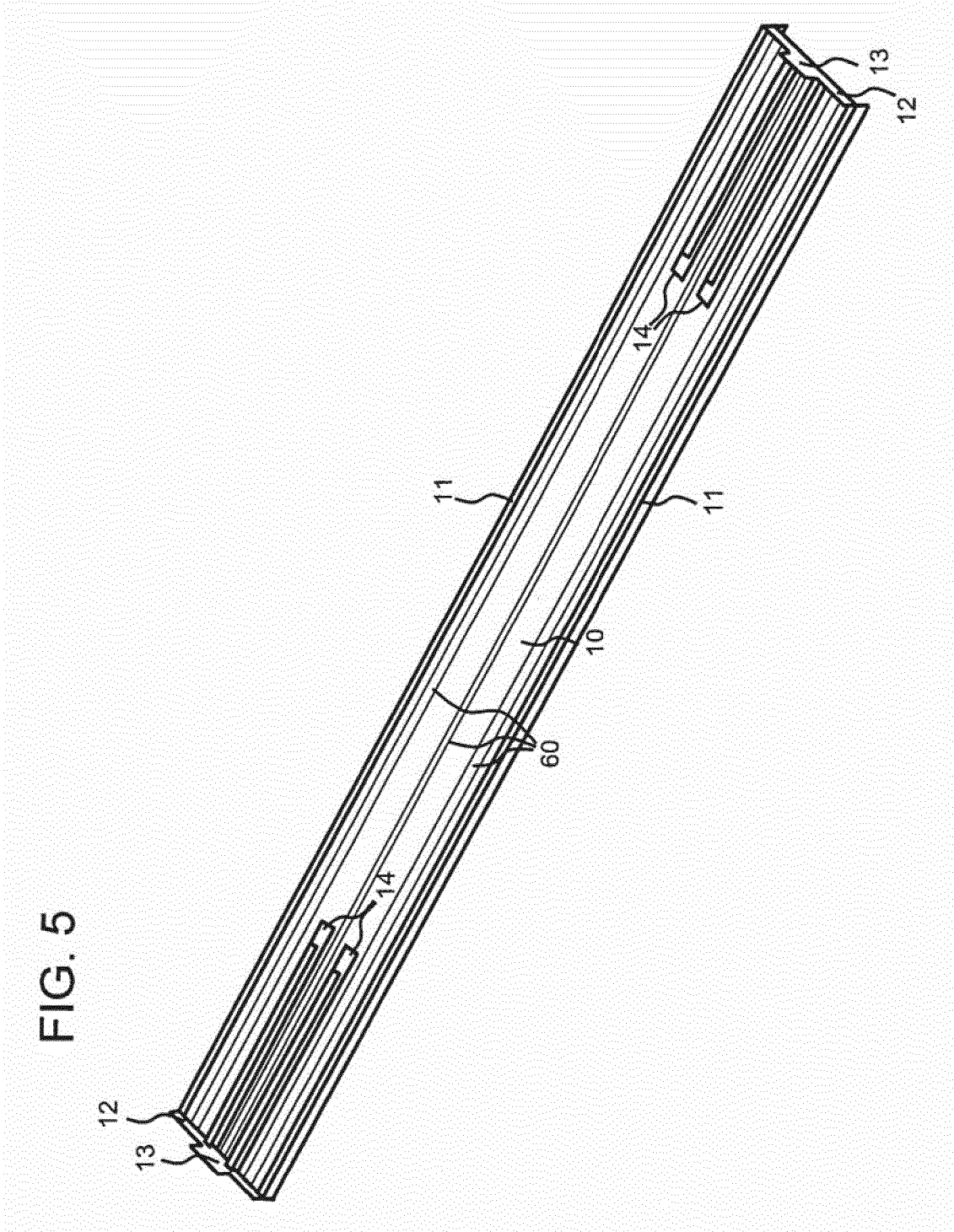


FIG. 6

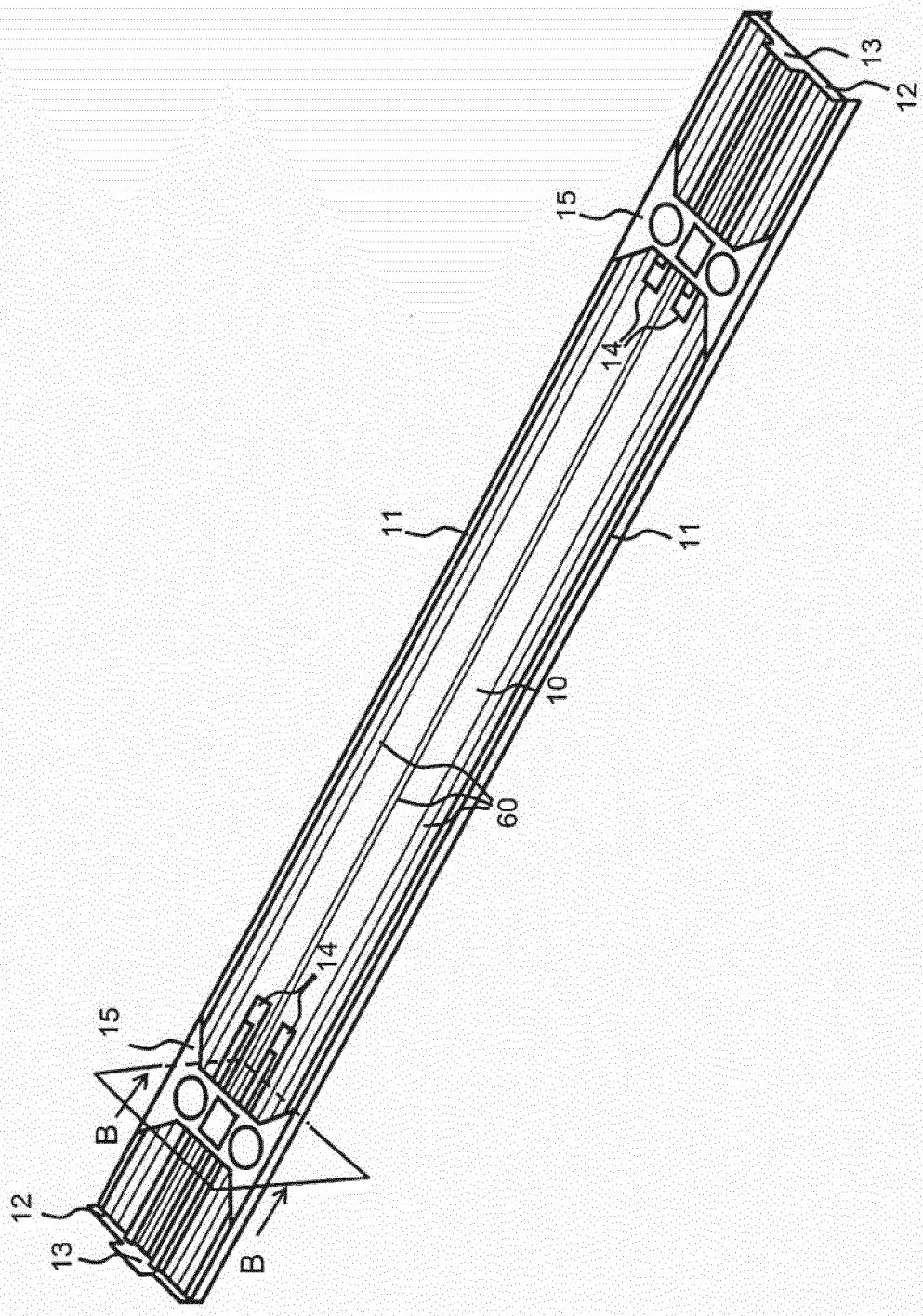


FIG. 7

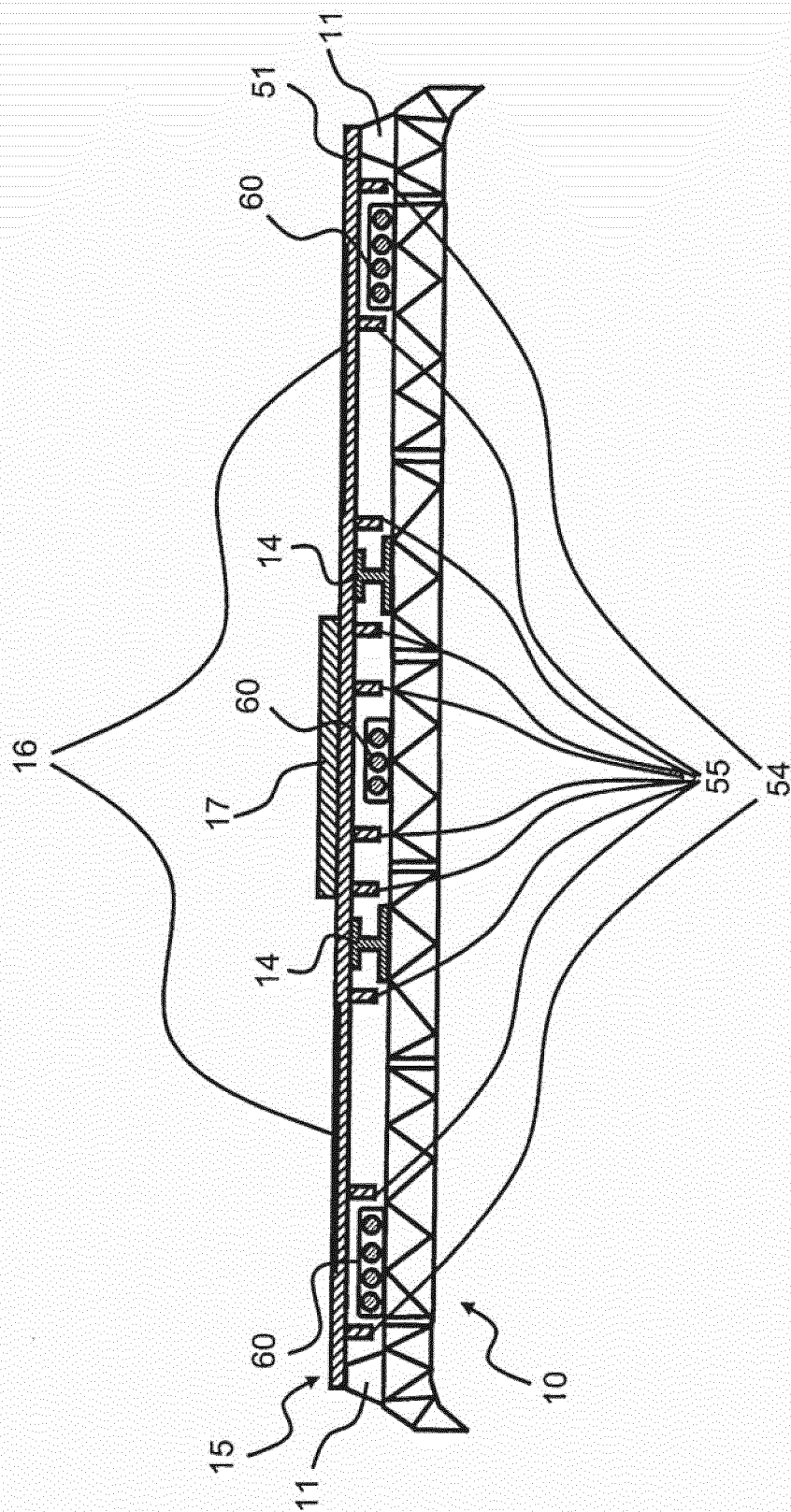
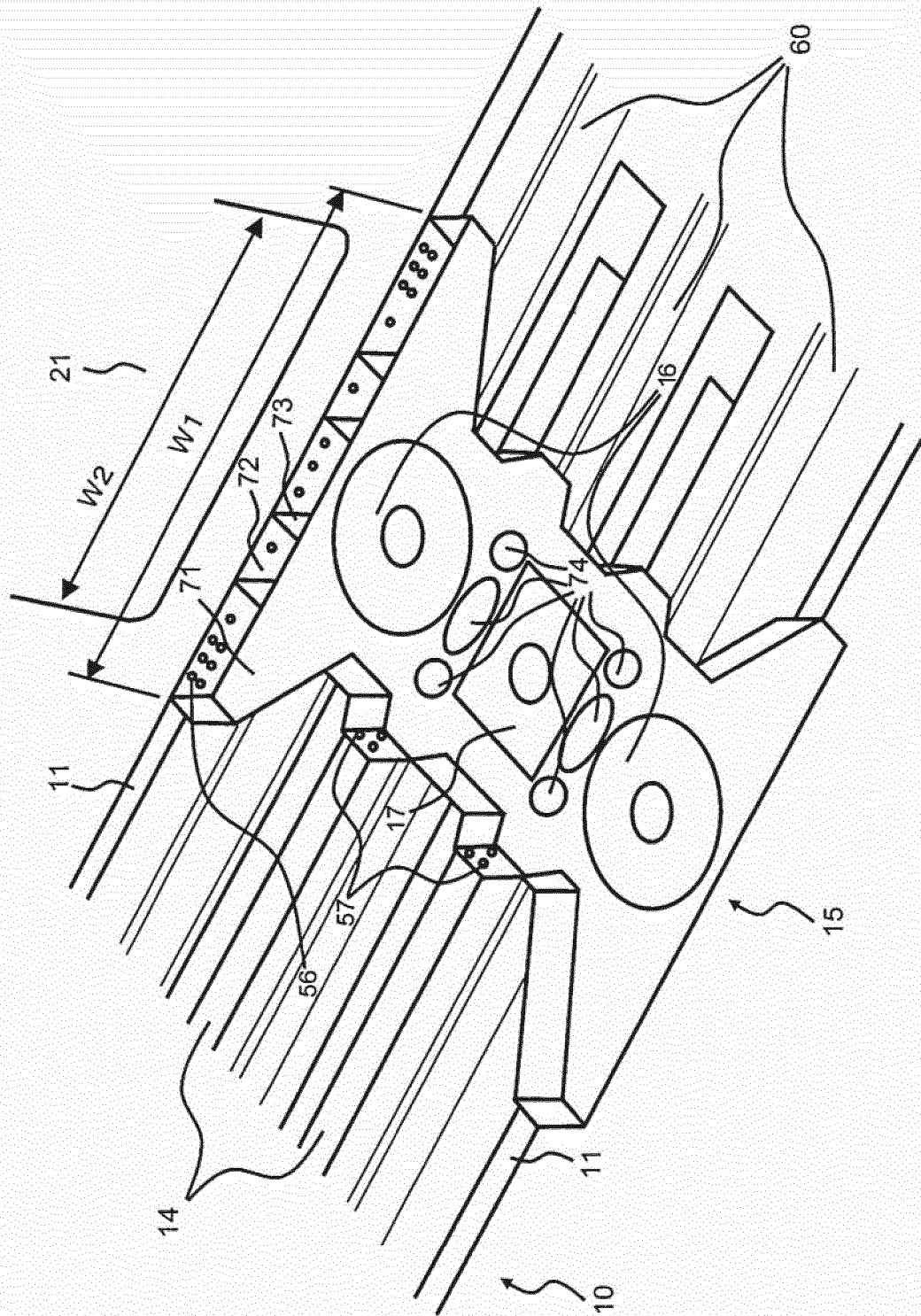


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/062855

A. CLASSIFICATION OF SUBJECT MATTER

B61F1/08(2006.01)i, B61D17/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61F1/00-1/14, B61D17/00-17/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012

Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002-178913 A (Hitachi, Ltd.), 26 June 2002 (26.06.2002), paragraph [0010]; fig. 3 & US 2002/0069787 A1 & EP 1213201 A2 & AU 2320501 A & KR 10-2002-0046130 A & CN 1358646 A	1-10
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 151984/1981 (Laid-open No. 54974/1983) (Japan National Railways, The Kinki Sharyo Co., Ltd.), 14 April 1983 (14.04.1983), entire text; all drawings (Family: none)	1-10

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

06 August, 2012 (06.08.12)

Date of mailing of the international search report

14 August, 2012 (14.08.12)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/062855

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 060736/1975 (Laid-open No. 140907/1976) (Hitachi, Ltd.), 13 November 1976 (13.11.1976), entire text; all drawings (Family: none)	2, 10
Y	JP 2006-290027 A (Hitachi, Ltd.), 26 October 2006 (26.10.2006), paragraphs [0007] to [0008]; fig. 1 & US 2006/0225604 A1 & US 2008/0276831 A1 & EP 1710144 A1 & KR 10-0747139 B1 & CN 1843819 A & AT 486756 T	3, 9
Y	JP 2002-145060 A (The Kinki Sharyo Co., Ltd.), 22 May 2002 (22.05.2002), entire text; all drawings (Family: none)	4, 9
Y	US 2280146 A (O. C. DURYEA CORP.), 21 April 1942 (21.04.1942), entire text; all drawings (Family: none)	5-7
Y	JP 2008-1186 A (Kawasaki Heavy Industries, Ltd.), 10 January 2008 (10.01.2008), paragraph [0040]; fig. 6-1	6
Y	JP 2006-224781 A (East Japan Railway Co., Kawasaki Heavy Industries, Ltd.), 31 August 2006 (31.08.2006), entire text; fig. 2 (Family: none)	7, 9
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 108409/1989 (Laid-open No. 47273/1991) (Hitachi, Ltd.), 01 May 1991 (01.05.1991), entire text; fig. 1 to 2 (Family: none)	8
A	JP 2010-173628 A (Hitachi, Ltd.), 12 August 2010 (12.08.2010), entire text; all drawings & EP 2204309 A1 & CN 101767595 A & KR 10-2010-0081264 A	1-3

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/062855

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, A	JP 2012-6461 A (Hitachi, Ltd.), 12 January 2012 (12.01.2012), entire text; all drawings (Family: none)	1
A	JP 59-2965 A (Nippon Sharyo, Ltd.), 09 January 1984 (09.01.1984), page 1, lower right column, line 10 to page 2, upper right column, line 1; fig. 2 (Family: none)	9

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/062855

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
(See extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/062855

Continuation of Box No.III of continuation of first sheet (2)

The matter common to the invention of claim 1 and the invention of claim 9 is "a vehicle body structure comprising an underframe formed by joining side beams, bolster beams, and center beams, the side beams being provided at both ends of the vehicle body in the width direction thereof so as to extend in the longitudinal direction of the vehicle body, the bolster beams being provided so as to extend in the width direction of the vehicle body, the center beams being provided so as to intersect the bolster beams and extend in the longitudinal direction of the vehicle body toward the ends of the vehicle body. However, the above configuration is disclosed in document 1 (JP 2002-178913 A (Hitachi, Ltd.), 26 June 2002 (26.06.2002), paragraph [0010], fig. 3) and makes no contribution over the prior art. Therefore, the configuration is not a special technical feature within the meaning of PCT Rule 13.2, second sentence.

Therefore, there is no matter common to the invention of claim 1 and the invention of claim 9.

Consequently, it is obvious that the invention of claim 9 does not comply with the requirement of unity of invention.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2009255641 A [0007]